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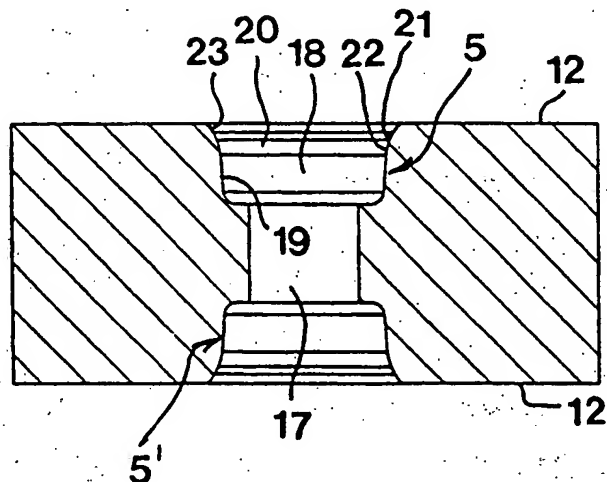
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(21) International Application Number: PCT/SE98/02220 (22) International Filing Date: 3 December 1998 (03.12.98) (30) Priority Data: 9704482-0 3 December 1997 (03.12.97) SE (71) Applicant (for all designated States except US): SANDVIK AKTIEBOLAG [SE/SE]; S-811 81 Sandviken (SE). (72) Inventor; and (75) Inventor/Applicant (for US only): SJÖÖ, Sture [SE/SE]; Gamla Furuviksvägen 47, S-805 92 Gävle (SE). (74) Agent: BENTON, Richard; Sandvik Aktiebolag, S-811 81 Sandviken (SE).		(81) Designated States: CN, JP, KR, US, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i> <i>In English translation (filed in Swedish).</i>

(54) Title: **CERAMIC CUTTING INSERT**

(57) Abstract

The invention relates to a ceramic cutting insert for cutting tools of the type which include a clamp with a nose intended to grip into a recess (5) in the cutting insert in order to keep the cutting insert firmly in place in an insert seat in a tool holder. The recess (5) has a rotationally symmetrical shape and comprises an inner cavity (18) which is delimited by a cylindrical or slightly conical wall surface (19) said cavity extends from the far end of the inner cavity and expands outwards by ever increasing its diameter in the direction from the inner cavity to the entrance opening in the said upper or lower sides.



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Ceramic cutting insertBackground of the Invention

The present invention relates to a ceramic cutting
5 insert for a cutting tool of the type which comprises a tool
holder with a seat intended to accept the cutting insert, the
shape of which partially corresponds to that of the cutting
insert, and a clamp which is connected to the holder via a
screw the object of which is to clamp the cutting insert firmly
10 in the seat, said clamp features a nose provided to grip into
one of the two recessed openings on opposite upper and lower
sides on the cutting insert so that when the screw is tightened
the cutting insert is drawn into the seat so that at least one
side surface of the insert is tightly pressed against a
15 corresponding side surface of the seat.

Prior art

A cutting tool, including a cutting insert and a tool
holder in general of the type described above, is earlier known
20 through SE 9401822-3. In this case the recess in the cutting
insert has the form of a transverse, cylindrical hole, which
like the nose of the clamp is generally cylindrical in shape,
although inclined in relationship to the cylindrical hole in
the cutting insert. The length of the nose is relatively large,
25 whereby the point of contact between the nose and the
cylindrically shaped inner wall of the hole is located
relatively far down in the hole. This cutting tool has been
found to work largely without problems in practical use.

Another cutting tool, of the type generally indicated in
30 the preamble, is known from EP 0 074 601. In this case the
recess in the cutting insert has the shape of an comparatively
shallow recess with a basic shape of either a four leaf clover
or a figure of eight, at the same time the nose of the clamp
has a half cylindrical or half barrel like shape, whereby the
35 longitudinal extension of the nose is oriented at right angles
to the actual longitudinal extension of the clamp. Through this
design a point contact is attained between the nose and the
inside surface of the recess. A drawback with this design,

however, is that the longitudinal extension of the clamp must always be located in the direction of the bisector between diametrically opposite corners on a quadrilateral shaped cutting insert, e.g. a square or rhombic shaped insert. For this reason cutting tools of this type are difficult to use in machines where two or more cutting inserts are to be placed near each other.

Irrespective of the type of tool the cutting insert is always a replaceable component with a limited life, whilst the tool holder is of a more long-lived character. In practice therefore the cutting insert can thus have an effective life of some few hours, whilst the life of the tool holder can extend to months or years. Cutting tools are to be found on the market belonging to both the first mentioned and the latter type but not only in such a way that different users use different types of tools but also in such a way that one and the same user or machine owner can have both types of tools. This fact entails both organizational as well as logistical problems as far as the supply of cutting inserts for tools must be arranged via different channels since the cutting inserts are specially designed to fit the different tool types individually.

Purposes and features of the invention

The aim of the present invention is to solve the above-mentioned problem by creating a new cutting insert for both types of tool. A basic purpose of the present invention is thus to create a ceramic insert which can be used universally for cutting tools according to both SE 9401822-3 and EP 0 074 601 and which furthermore permits the use of variable adjustments of the angular position of the clamp relative to the insert even in those cases when the tool is of the type which is described in EP 0 074 601. An additional purpose is to create a ceramic insert, which lends itself to an easy and economic method of manufacture despite the fact of its ability to fit into both types of tool.

At least the main aim of the invention is achieved by the features of the invention, which are described in the "characterized in" part of claim 1. A further advantageous

embodiment of the invention is given in the independent claim 2.

Short description of enclosed drawings

- 5 The drawings are comprised of:
- Fig 1 a partial longitudinal section (A-A in fig 2) through a tool according to SE 9401822-3,
- Fig 2 a plan view from above of the clamp of the tool and the cutting insert,
- 10 Fig 3 a longitudinal section through only the actual clamp and a cutting insert according to the invention co-operating therewith,
- Fig 4 an enlarged longitudinal section through the cutting insert according to the invention,
- 15 Fig 5 a perspective view of the same cutting insert,
- Fig 6 a plan view of the cutting insert,
- Fig 7 a longitudinal section through an alternative embodiment of the cutting insert according to the invention,
- Fig 8 a schematic longitudinal section through a clamp to the tool according to EP 0 074 601 in co-operation with the cutting insert according to the invention,
- 20 Fig 9 a schematic side view of the clamp and the cutting insert according to fig 8,
- Fig 10 a planar section (B-B in fig 9) through the cutting insert alone,
- 25 Fig 11 a planar view illustrating how the clamp on the tool according to SE 9401822-3 can be installed in different angles relative to the insert, and
- Fig 12 a corresponding planar view showing also how the clamp on the tool according to EP 0 074 601 in analogous manner allows itself to be oriented in different positions relative to the cutting insert.
- 30

Detailed description of the preferred embodiments of the invention

- 35 The cutting tool produced according to SE 9401822-3 as illustrated in fig 1 and 2 includes three main components, that is to say a holder 1, a clamp 2 as well as a cutting insert 3. The cutting insert 3 is produced in a ceramic material, whilst

the holder and clamp are customarily made of steel. The clamp 2 has an elongated basic shape and features at an external, free end a nose 4 which has as its function to lock into a recess, which is designated 5, in the cutting insert 3. This nose has a cylindrical basic shape, however the nose is inclined relative to the longitudinal or centre axis of the recess. The clamp is linked to the holder 1 via a screw 6 which can be screwed down into a threaded hole 7 in the holder, more exactly against the effect of a spring 8 which strives to lift the clamp towards an outer position. A pin 9, which acts as a stop ensures that the clamp does not twist itself as the screw is tightened. In the region of its rear end the clamp features an inclined surface 10 which abuts against a surface 11 on the holder 1 which is inclined in a similar manner. Through co-operation between these surfaces 10, 11 the effect is created as the screw is tightened by which the nose 4 is not only pressed in a downwards direction but it also moves in a rearward direction in order to draw the cutting insert 3 into a seat in the holder 1.

Said seat has a shape, which partially corresponds to that of the cutting insert, however this is not illustrated in the drawings. In the example given according to fig 1-2 the cutting insert 3 has a polygonal, more specifically a rhombic basic shape, wherein same is delimited by planar upper and lower sides 12, 12' plus four side faces 13. In this connection however it should be pointed out that the insert may have whatever arbitrary basic form, for example square or circular. The example also shows how a shim 14 may be introduced between the cutting insert 3 and the bottom 15 of the insert pocket. This shim is held in place with the help of a screw 16.

As far as the illustrated cutting tool has been described so far it is the same in all significant features as has been known earlier from SE 9401822-3.

Now reference is made to figs 3-6, which illustrate in more detail a first embodiment of the cutting insert according to the invention. Hereby the invention is thought to be applied in connection with an indexable cutting insert. For this reason the cutting insert includes two opposite recesses 5, 5'

designed to receive the nose 4 of the clamp finger 2. Recesses 5, 5' are diametrically opposite each other, in addition an open channel 17 extends between them.

Characteristic for the cutting insert according to the invention is that the individual recesses 5, 5' have a rotationally symmetrical shape and comprise partly an inner cavity 18 which is delimited by a cylindrical or slightly conical surface 19, partly an external cavity 20 which extends from the far end of the inner cavity and expands outwards by ever increasing its diameter in the direction from the inner cavity to the entrance opening in the upper surface 12 (respectively the bottom side 12') of the cutting insert. The external cavity 20 is delimited by at least two ring-shaped partial surfaces, namely a first, conical surface portion 21 and a second, convex dome-shaped surface portion 22, which extends between the inner cavity 18 and conical surface 21. In the particularly preferred embodiment which is shown in the drawings the external cavity 20 is delimited also by a third surface portion 23 in the shape of an convex dome-shaped surface portion which extends between the conical surface 21 and the planar upper surface 12 (respectively the bottom surface 12') on the cutting insert.

As is distinctly shown in fig 3 the comparatively long nose 4 on the clamp finger 2 will come to abut against the inner surface wall 19 of the cavity 18 when achieving point or linear contact between the nose and surface wall. Hereby a distinct and reliable transfer of the required forces from the clamping finger and nose to the insert is attained in connection with the insert being drawn into its corresponding seat in the tool holder.

The alternative embodiment of the cutting insert, which is shown in fig 7, differs from the cutting insert described above only in that the transverse channel 17 is lacking. In this manner the two recesses 5, 5' are separated by a central portion of material. This means that the cutting insert - for a given dimension - contains more material and thereby has greater strength.

Now reference is made to fig 8-10 which illustrates schematically a clamp of the type which is part of the cutting tool according TO EP 0 074 601. Basically this clamp differs from the clamps shown in figs 1 and 3 only in that the nose 4' has a half cylindrical or half barrel like shape. As is shown fig 10 the nose is long and narrow and extends with its longside at right angles to the clamp's 2' longside. The opposed side faces 24, 24' on the nose narrow off not only in the forward direction, as is shown in fig 10, but also in the downwards direction (which is not apparent from fig 10).

When the nose 4' is brought to engage in the recess 5 of the cutting insert and the screw of the clamp is tightened point contact is obtained, more exactly at two points 25, 25' between the nose and at least one of the partial surfaces which delimits the outer cavity 20 of the recess. More exactly two point contact will occur against the conical partial surface 21 or the dome-shaped partial surface 22 which exist between the conical surface and the wall surface 19 which delimits the inner cavity 18; all being dependent on the condition of the nose regarding, for example, the degree of wear. Even in this case a distinct pressing of the nose against the inside of the recess is attained, namely against the said partial surfaces in the external cavity. Since the cavity has a rotationally symmetrical shape it is ensured that the said point contact is attained irrespective of the clamp's angular position relative to the insert. This is clearly shown in fig 12 which illustrates how the clamp 2' can be installed in different positions in relation to the cutting insert (and vice versa). The only purpose of fig 11 is to clarify that the same variation of the angular position can happen at clamp 2 according to SE 9401822-3;

The cutting insert according to the invention can be manufactured in different versions with mutually different dimensions. In practice the cutting insert can have a thickness of the magnitude of 5-7 mm. Generally the diameter of the inner cavity 18 varies in accordance with the thickness of the insert. If the cutting insert is thin this diameter can be of the order of up to 3,8 mm, whilst the same diameter for the

thickest the cutting insert can be up to 6,5 mm. In a medium thick t embodiment the diameter of the cavity 18 can be up to about 5 mm. Further the depth of the cavity 18 can vary in accordance with the dimensions of the cutting insert. In a medium thick cutting insert with a diameter of 5 mm can the depth of the cavity 18 be of the order of 0,8-1,2 mm, preferably about 1 mm. Even the depth of the external cavity 20 can vary, as can also the depths of the separate partial surfaces 21, 22 and 23. In practice the external cavity 20 can have a total depth of the magnitude of 0,8-1,5 mm, suitably 1,0-1,3 mm. Both the partial surfaces 22, 23 can have about just as large a depth, e.g. in the range of 0,3-0,6 mm, suitably 0,4-0,5 mm, whilst the intermediate partial surface 21, has a shallower depth, e.g. in the range of 0,25-0,5 mm, suitably 0,3-0,4 mm. In practice the total depth for the different partial surfaces 21, 22 and 23 can be about just as great as the depth of the inner cavity 18.

Regarding the conical surface 21 it should be pointed out that the angle of the cone could lie in the range of 35-55°. However the lower limit can be larger than 35°, e.g. 40° or 42°. In an analogous manner the upper limit can be less than 55°, e.g. 50° or 48°. In practice a cone angle of 45-46° is preferred.

The radius of curvature of the external dome-shaped partial surface 23 can amount to about 1 mm, whilst the radius of curvature of the inner dome-shaped partial surface 22 can lie in the range of 0,7-1,0 mm.

A significant advantage with the cutting insert according to the invention is that the insert can be used universally in cutting tools according to both SE 9401822-3 and EP 0 074 601. To make doubly sure, the cutting insert furthermore allows the clamp to be angled relative to the bisector of a polygonal or square cutting insert, something which is not possible when using inserts according to EP 0 074 601. This means that machine owners who use both types of cutting tool can use one and the same cutting insert throughout and in this manner avoid costly difficulties with regard to tool stocks and other organizational problems in

connection with the supply of cutting inserts for the tools.

Claims

1. Ceramic cutting insert for a cutting tool of the type which comprises a holder (1) with an insert seat intended for the acceptance of the cutting insert (3) the shape of which partially corresponds to the shape of the cutting insert, and a clamp (2) which is connected to the holder via a screw (6) the function of which is to firmly clamp the cutting insert in the seat, said clamp (2) features a nose (4) provided to grip into one of two recesses (5) which have their openings on opposite upper and lower sides (12, 12') on the cutting insert in order to pull the cutting insert into the insert seat and press tightly at least one side surface of the cutting insert against a corresponding side surface in the insert seat when the screw (6) is tightened,

characterized in that, the recess (5) has a rotational symmetrical shape and comprises an inner cavity (18) an inner cavity (18) which is delimited by a cylindrical or slightly conical wall surface (19) said cavity extends from the far end of the inner cavity and expands outwards by ever increasing its diameter in the direction from the inner cavity to the entrance opening in the said upper or lower sides (12, 12'), and that the external cavity (20) is delimited by at least two ring shaped partial surfaces, namely a first, conical partial surface (21) and a second, convex dome-shaped partial surface (22) which extends between the inner cavity (18) and the conical surface (21).

2. Ceramic cutting insert according to claims 1, characterized in that, the external cavity (20) besides the said first and second partial surfaces (21, 22) is also delimited by a third, convex dome shaped partial surface (23) which extends between the conical surface (21) and said upper or lower side (12, 12') on the cutting insert.

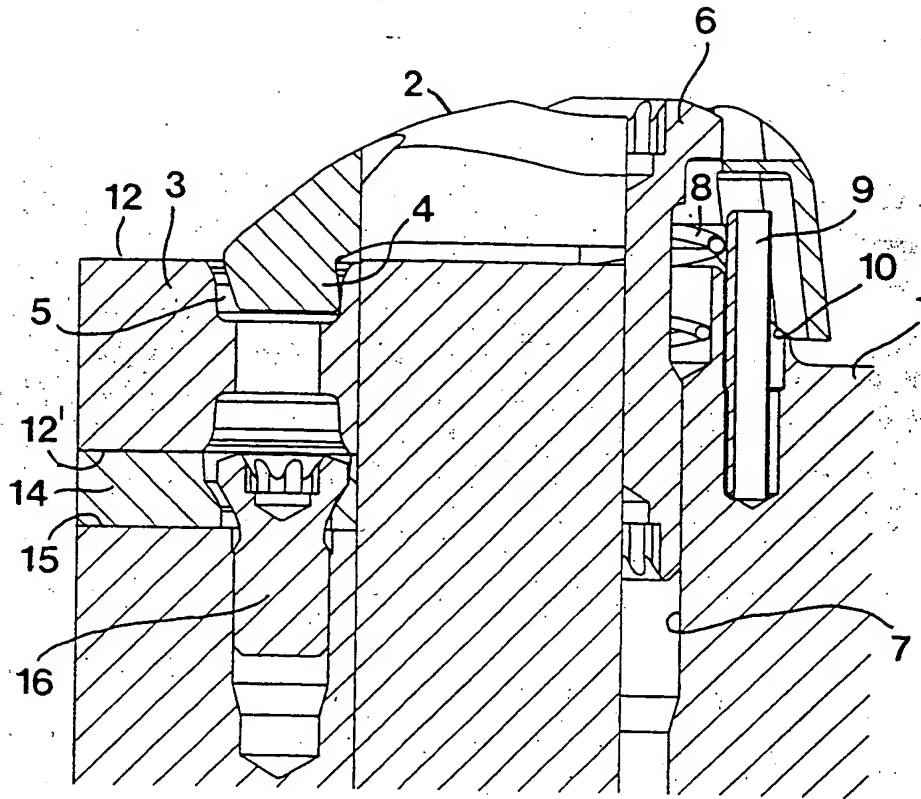
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Fig 1

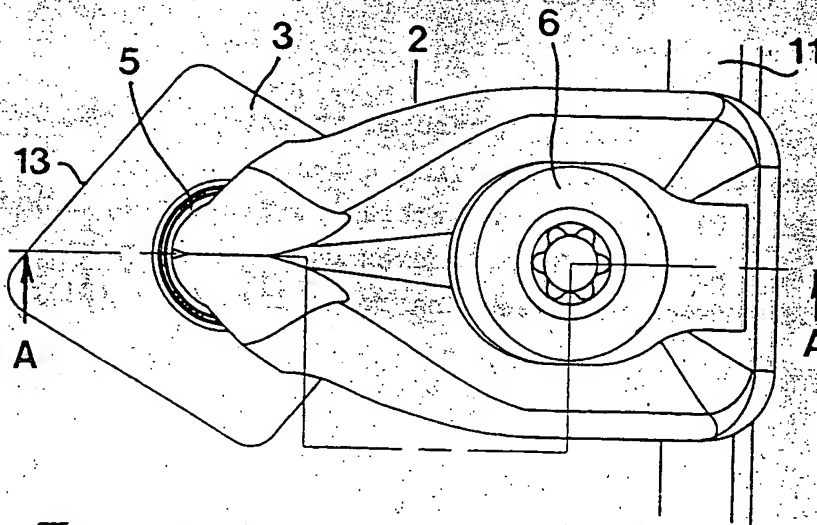


Fig 2

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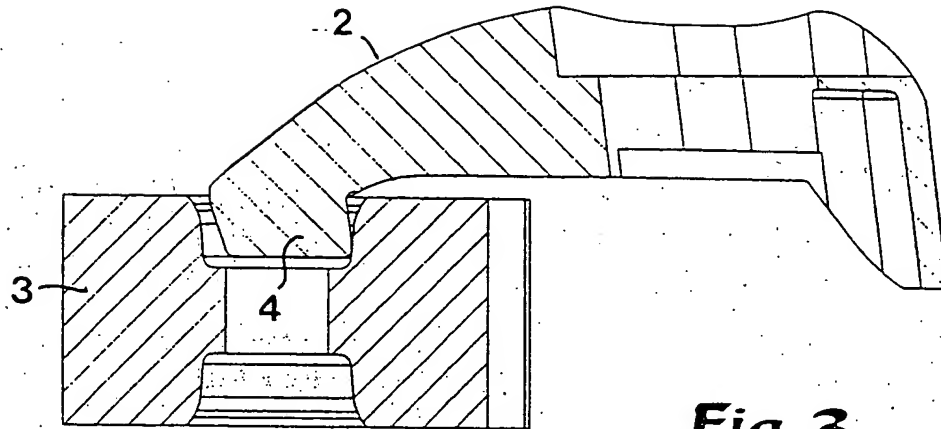


Fig 3

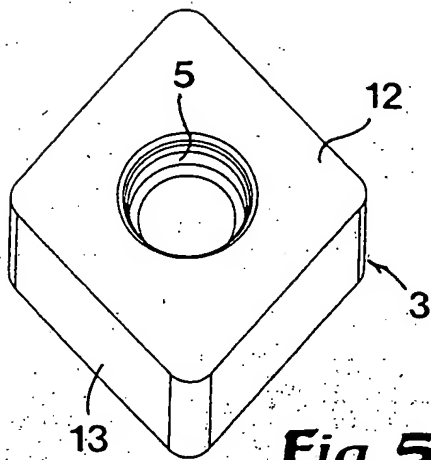


Fig 5

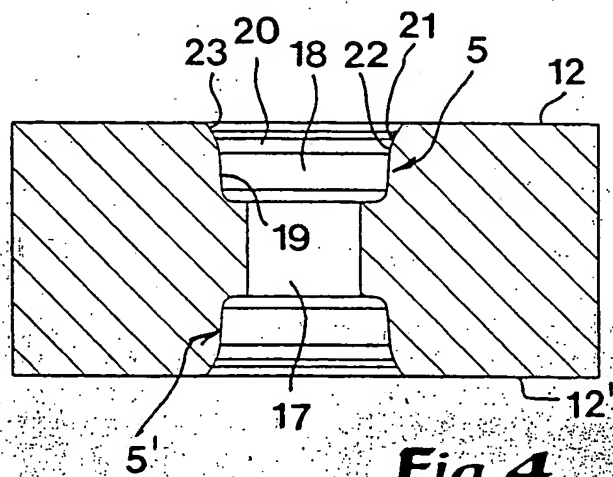


Fig 4

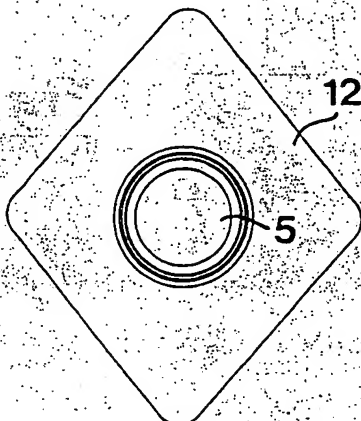


Fig 6

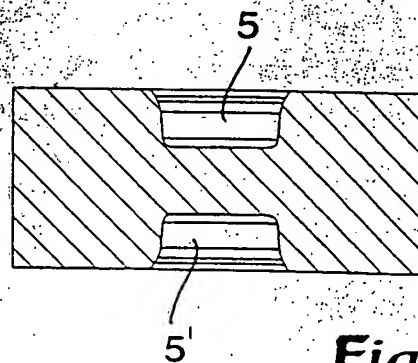


Fig 7

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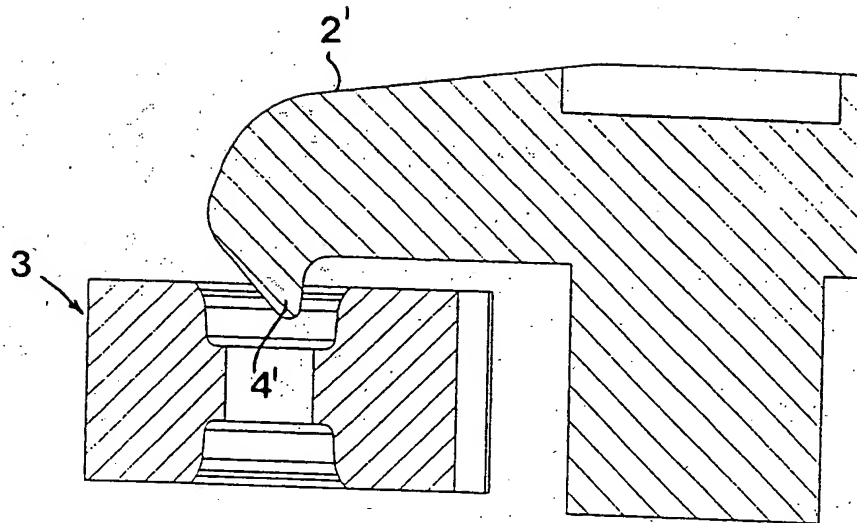


Fig 8

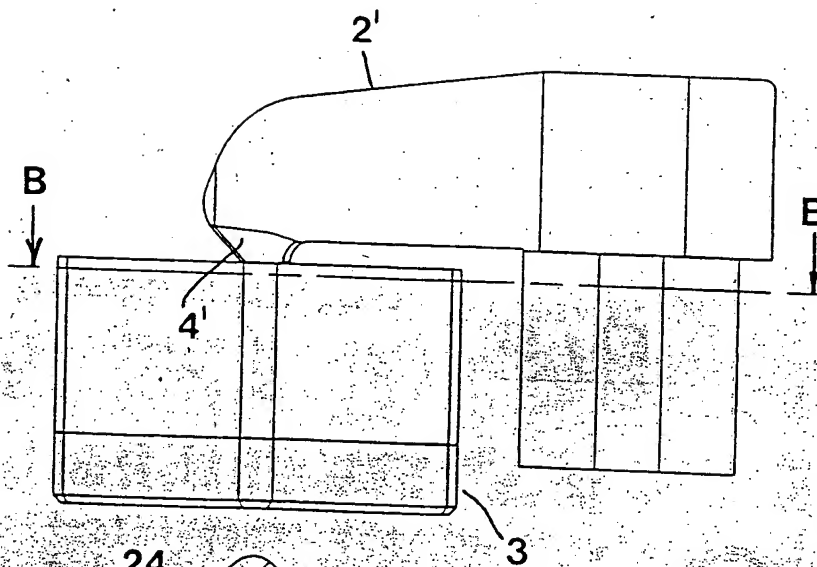


Fig 9

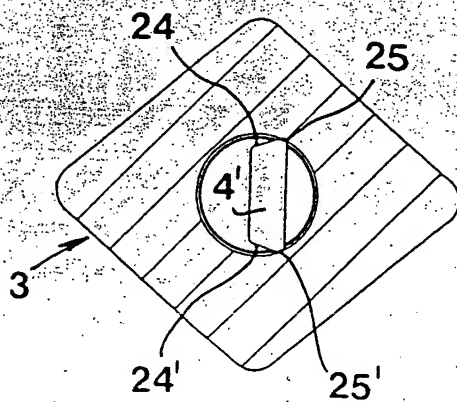
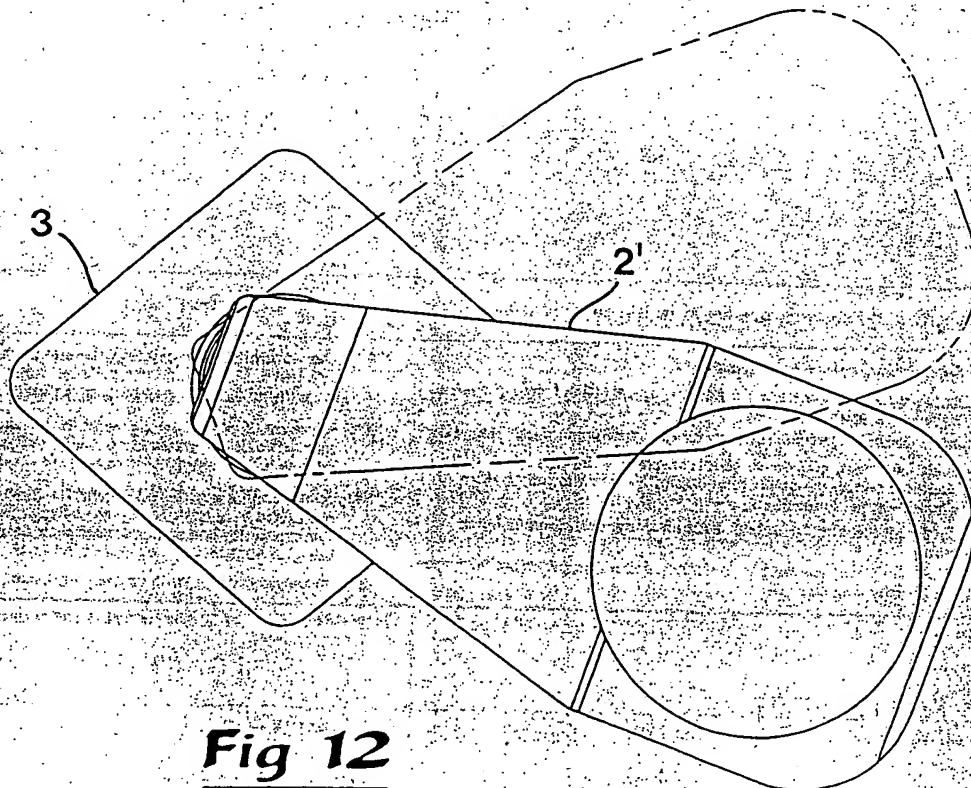
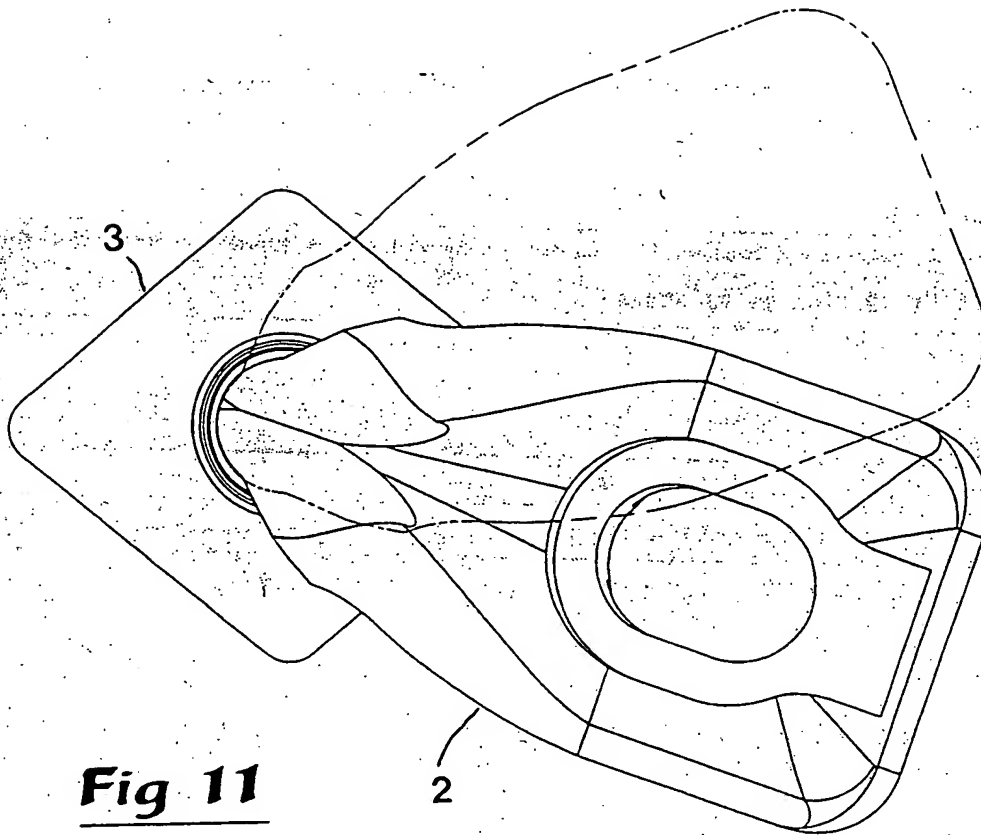


Fig 10



INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 98/02220

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B23B 27/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4697963 A (LUCK), 6 October 1987 (06.10.87), figure 2, abstract	1-2
A	EP 0074601 A1 (FELDMÜHLE AKTIENGESellschaft), 23 March 1983 (23.03.83), figure 1, abstract	1-2
A	DE 4209084 A1 (NEUMO GRUNDBESITZ-GMBH), 23 Sept 1993 (23.09.93), figure 1, abstract	1-2

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Information on patent family members

02/02/99

International application No.

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4697963 A	06/10/87	BR 8600527 A DE 8527924 U	21/10/86 21/11/85
EP 0074601 A1	23/03/83	SE 0074601 T3 AT 20839 T DE 3136502 A JP 58059705 A US 4477212 A	15/08/86 31/03/83 08/04/83 16/10/84
DE 4209084 A1	23/09/93	NONE	

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